Name _____ Date _____ Class _____

5 ATOMIC STRUCTURE AND THE PERIODIC TABLE

SECTION 5.1 ATOMS (pages 107–108)

This section describes early atomic theories of matter and provides ways to understand the tiny size of individual atoms.

▶ Early Models of the Atom (pages 107–108)

1. Democritus of Abdera, who lived in Greece during the fourth century B.C., suggested that matter is made up of tiny particles that cannot be divided. He called these particles _____ .

2. List two reasons why the ideas of Democritus were not useful in a scientific sense. _____

_____

3. The modern process of discovery about atoms began with the theories of an English schoolteacher named _____ .

4. Circle the letter of each sentence that is true about Dalton's atomic theory.

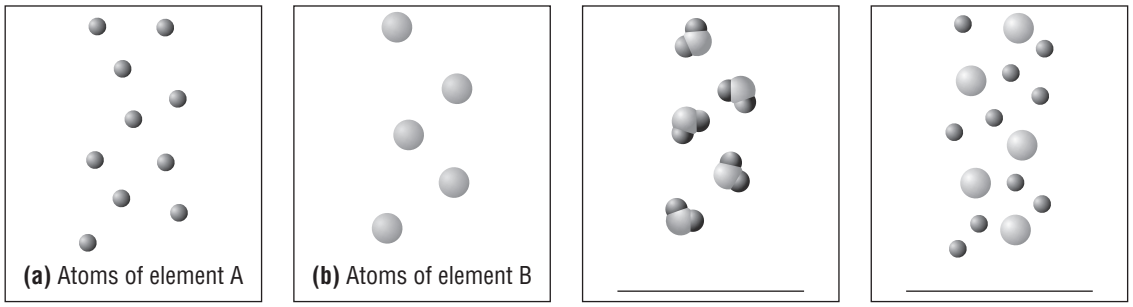
a. All elements are composed of tiny, indivisible particles called atoms.

b. An element is composed of several types of atoms.

c. Atoms of different elements can physically mix together, or can chemically combine in simple, whole-number ratios to form compounds.

d. Chemical reactions occur when atoms are separated, joined, or rearranged; however, atoms of one element are never changed into atoms of another element by a chemical reaction.

5. In the diagram, use the labels *mixture* and *compound* to identify the mixture of elements A and B and the compound that forms when the atoms of elements A and B combine chemically.



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▶ Just How Small Is an Atom? (page 108)

6. Suppose you could grind a sample of the element copper into smaller and smaller particles. The smallest particle that could no longer be divided, yet still has the properties of copper, is _____ .

7. About how many atoms of copper when placed side by side would form a line 1 cm long? _____

SECTION 5.2 STRUCTURE OF THE NUCLEAR ATOM (pages 109–112)

This section describes the experiments that led to the discovery of subatomic particles and their properties.

▶ Electrons (pages 109–110)

1. How is the atomic theory that is accepted today different from Dalton's atomic theory? _____

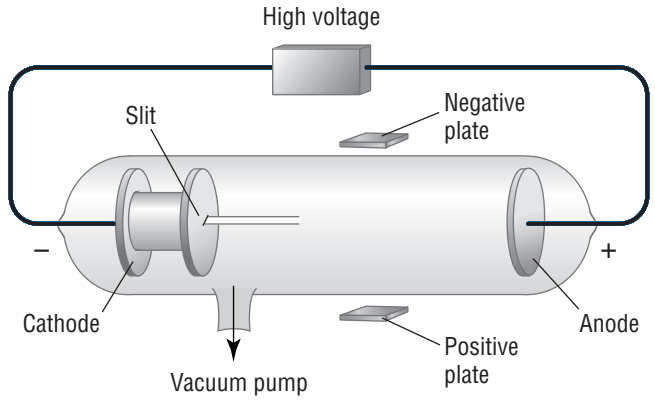
_____

2. Which subatomic particles carry a negative charge? _____

Match each term from the experiments of J. J. Thomson with the correct description.

_____ **3.** anode	**a.**	an electrode with a negative charge
_____ **4.** cathode	**b.**	a glowing beam traveling between charged electrodes
_____ **5.** cathode ray	**c.**	an electrode with a positive charge
_____ **6.** electron	**d.**	a negatively charged particle

7. The diagram shows electrons moving from left to right in a cathode-ray tube. Draw an arrow showing how the path of the electrons will be affected by the placement of the negatively and positively charged plates.



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8. Thomson observed that the production of cathode rays did not depend on the kind of gas in the tube or the type of metal used for the electrodes. What conclusion did he draw from these observations?

_____

9. What two properties of an electron did Robert Millikan determine from his experiments?

_____

▶ Protons and Neutrons (pages 110–111)

10. Circle the letter of each sentence that is true about atoms, matter, and electric charge.

a. All atoms have an electric charge.

b. Electric charges are carried by particles of matter.

c. Electric charges always exist in whole-number multiples of a single basic unit.

d. When a given number of positively charged particles combines with an equal number of negatively charged particles, an electrically neutral particle is formed.

11. Circle the letter next to the number of units of positive charge that remain if a hydrogen atom loses an electron.

a. 0 **b.** 1 **c.** 2 **d.** 3

12. The positively charged subatomic particle that remains when a hydrogen atom loses an electron is called _____ .

13. What charge does a neutron carry? _____ .

14. Complete the table about the properties of subatomic particles.

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Properties of Subatomic Particles				
Particle	**Symbol**	**Relative Electrical Charge**	**Relative Mass** (mass of proton = 1)	**Actual Mass** (g)
Electron	e^-			9.11×10^{-28}
Proton	p^+			1.67×10^{-24}
Neutron	n^0			1.67×10^{-24}

▶ The Atomic Nucleus (pages 111–112)

15. Is the following sentence true or false? An alpha particle has a double positive charge because it is a helium atom that has lost two electrons. _____

16. Explain why in 1911 Rutherford and his coworkers were surprised when they shot a narrow beam of alpha particles through a thin sheet of gold foil.

_____

_____

_____

_____

_____

17. Circle the letter of each sentence that is true about the nuclear theory of atoms suggested by Rutherford's experimental results.

a. An atom is mostly empty space.

b. All the positive charge of an atom is concentrated in a small central region called the nucleus.

c. The nucleus is composed of protons and neutrons.

d. The nucleus is large compared with the atom as a whole.

e. Nearly all the mass of an atom is in its nucleus.

SECTION 5.3 DISTINGUISHING BETWEEN ATOMS (pages 113–121)

This section explains how atomic number identifies an element; how to use atomic number and atomic mass to find the number of protons, neutrons, and electrons in an atom; how isotopes differ; and how to calculate average atomic mass.

▶ Atomic Number (page 113)

1. Circle the letter of the term that correctly completes the sentence. Elements are different because their atoms contain different numbers of _____ .

a. electrons

b. protons

c. neutrons

d. nuclei

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2. Complete the table showing the number of protons and electrons in atoms of six elements.

Atoms of Six Elements				
Name	**Symbol**	**Atomic Number**	**Number of Protons**	**Number of Electrons**
Hydrogen	H	1		
Helium	He		2	
Lithium	Li	3		
Boron	B	5		
Carbon	C	6		
Oxygen	O			8

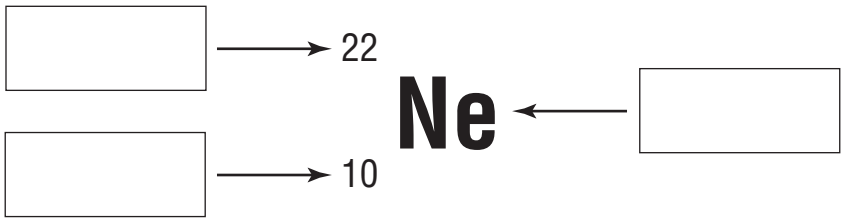
▶ Mass Number (pages 115–116)

3. The total number of protons and neutrons in an atom is its _____ .

4. What is the mass number of a helium atom that has two protons and two neutrons? _____

5. How many neutrons does a beryllium atom with four protons and a mass number of nine have? _____

6. Place the labels *chemical symbol, atomic number,* and *mass number* in the shorthand notation below.



7. Designate the atom shown in Question 6 in the form "name of element"-"mass number." _____

8. How many protons, neutrons, and electrons are in the atom discussed in Questions 6 and 7? Protons: ____ Neutrons: ____ Electrons: ____

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CHAPTER 5, Atomic Structure and the Periodic Table *(continued)*

▶ Isotopes (pages 116–117)

9. How do atoms of neon-20 and neon-22 differ?

_____

_____

10. Neon-20 and neon-22 are called _____ .

11. Is the following sentence true or false? Isotopes are chemically alike because they have identical numbers of protons and electrons. _____

Match the designation of each hydrogen isotope with its commonly used name.

_____ **12.** hydrogen-1 **a.** tritium

_____ **13.** hydrogen-2 **b.** hydrogen

_____ **14.** hydrogen-3 **c.** deuterium

▶ Atomic Mass (pages 118–121)

15. Why is the atomic mass unit (amu), rather than the gram, usually used to express atomic mass?

_____

_____

16. What isotope of carbon has been chosen as the reference isotope for atomic mass units? What is the defined atomic mass in amu of this isotope?

_____

17. Is the following sentence true or false? The atomic mass of an element is always a whole number of atomic mass units. _____

18. Circle the letter of each statement that is true about the average atomic mass of an element and the relative abundance of its isotopes.

a. In nature, most elements occur as a mixture of two or more isotopes.

b. Isotopes of an element do not have a specific natural percent abundance.

c. The average atomic mass of an element is usually closest to that of the isotope with the highest natural abundance.

d. Because hydrogen has three isotopes with atomic masses of about 1 amu, 2 amu, and 3 amu, respectively, the average atomic mass of natural hydrogen is 2 amu.

19. Circle the letter of the correct answer. When chlorine occurs in nature, there are three atoms of chlorine-35 for every one atom of chlorine-37. Which atomic mass number is closer to the average atomic mass of chlorine?

a. 35 amu **b.** 37 amu

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Reading Skill Practice

Outlining can help you understand and remember what you have read. Prepare an outline of Section 5.3, *Distinguishing Between Atoms.* Begin with the headings in the textbook. Under each heading, write the main idea. Then list the details that support the main idea. Do your work on a separate sheet of paper.

SECTION 5.4 THE PERIODIC TABLE: ORGANIZING THE ELEMENTS (pages 123–126)

This section describes the development of the periodic table and explains the arrangement of groups and periods in the modern periodic table.

▶ Development of the Periodic Table (page 123)

1. About how many elements had been discovered by the mid-1800s? _____

2. Who was Dmitri Mendeleev? _____

_____

_____

3. What variable did Mendeleev use to organize his version of the periodic table?

_____

4. Is the following sentence true or false? Mendeleev and other scientists were able to use the periodic table to predict the properties of undiscovered elements. _____

5. How did Moseley change the periodic table?

_____

▶ The Modern Periodic Table (pages 124–126)

6. Explain the color coding of the symbols in the periodic table on page 124.

_____

_____

_____

_____

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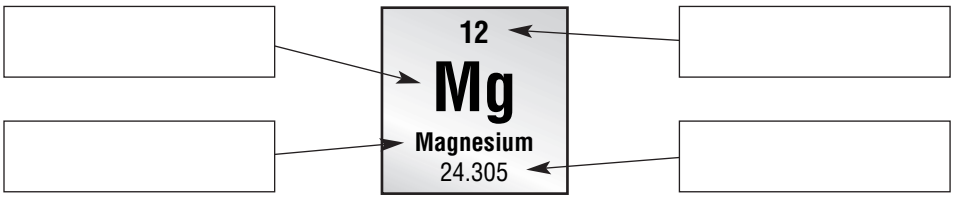
CHAPTER 5, Atomic Structure and the Periodic Table *(continued)*

7. Label the sample square from the periodic table below. Use the labels *name of element, chemical symbol, atomic number,* and *atomic mass.*



8. Use the data in Question 7 to determine how many protons are in the nucleus of each atom of magnesium. _____

9. The horizontal rows in the periodic table are called _____ .

10. Is the following statement true or false? The periodic law states that when elements are arranged in order of increasing atomic number, there is a periodic repetition of physical and chemical properties. _____

11. Why are Group A elements called representative elements?

_____

12. Complete the table concerning general properties of the broad classes of elements.

Class of Elements	General Properties
Metals	
Nonmetals	
Metalloids	properties are intermediate between metals and nonmetals

13. Classify each of the following elements as a (an) *alkali metal, alkaline earth metal, transition metal, halogen, noble gas,* or *metalloid.* Draw lines connecting elements in this table that have similar properties.

a. sodium _____

b. germanium _____

c. calcium _____

d. fluorine _____

e. xenon _____

f. copper _____

g. chlorine _____

h. silicon _____

j. potassium _____

k. magnesium _____

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